Measuring Urban Resilience As You Build It - Insights from 100 Resilient Cities[i]

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A Holistic Definition of Resilience That Addresses Urban Complexity

100 Resilient Cities (100RC) - pioneered by The Rockefeller Foundation, partners with cities in dozens of countries around the globe to develop and implement actions that build urban resilience. The 100RC Network is made up of practitioners at the forefront of an urban resilience movement who are often the earliest adopters and co-creators of resilience-building tools and methods. Our approach is centered on a holistic definition of resilience that integrates multiple schools of resilience thinking. In our work with partner cities we define resilience as *the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience*.

Of particular note about our holistic definition of resilience is that it addresses not only the impact of acute shocks, but also chronic stresses, and that it identifies the multi-scalar nature of urban resilience as resting on capacity existing at a range of levels from individuals to macro systems.

A Proactive and Holistic Approach to Managing Risk

A focus on building resilience differs from traditional approaches to risk management. Specifically it takes a systems approach, incorporates the threats posed by chronic stresses, produces integrated solutions that offer multiple benefits, and is adaptive to uncertain future scenarios.

Most critical to a resilience approach is consideration of how both shocks and stresses contribute to risk. When a catastrophe occurs it creates a cascade of impacts, exacerbating all the issues present before the event. Attention to day-to-day conditions such as social disparity, inadequate healthcare, and poorly constructed or aging infrastructure can limit the aftershocks felt when disasters occur, And just as shocks aggravate stresses, stresses can also accumulate and become shocks. For example rising unemployment can lead to rioting and civil unrest, and environmental degradation can cause

[i] This paper is part of the IRGC Resource Guide on Resilience, available at: https://www.irgc.org/risk-governance/resilience/. Please cite like a book chapter including the following information: IRGC (2016). Resource Guide on Resilience. Lausanne: EPFL International Risk Governance Center. *v29-07-2016*

deadly landslides and flooding. Notably—and a key part of building the urban resilience movement—a focus on chronic stresses not only reduces the potential they will exacerbate a shock, but it helps cities operate better in good times as well.

Addressing multiple shocks and stresses simultaneously requires a fundamentally integrative approach. It is especially appropriate for developing the type of adaptive solutions needed in urban places that face multiple uncertainties. It works well at the city scale where there are a multitude of decision-makers, and it is necessary to break down silos and work across sectors to understand how systems connect and impact each other. Strategies for building resilience demand a more holistic approach. Resilience actors ask 'how can we create a City that will thrive for generations to come in the face of multiple risks and an unknowable future?' 'How can we not only protect people's lives but also increase their livelihoods and access to opportunities?' 'How can we, with every dollar spent, connect systems to create multiple benefits across them?'

While the complex nature of building resilience presents many challenges, and can seem overwhelming, it has the potential to create greater efficiency and impact by integrating efforts and creating alignment across multiple stakeholders. The result is improvements today that will minimize future impacts and shorten recovery time.

As this holistic understanding of resilience takes hold in cities around the world, tools and methods are being developed to bring theory into practice, and cities are finding themselves at the forefront of innovating a new community of practice.

What Cities Need to Measure to Build Resilience

From Byblos to Bangalore to Boston, cities that partner with 100RC are diverse in risks, size, region, development, governance, and culture. How each city approaches building resilience looks a bit different, but common among them is a need for resilience measurement all along the journey. Methods used by cities for measuring or identifying resilience must be sound, but they must also connect to the types of objectives city stakeholders have, such as: gaining consensus and buy-in around what the city's resilience challenges are; designing initiatives that will contribute to the city's resilience; accessing financial and other resources necessary to implement; demonstrating impact on people's lives; and making the case for continued investment in building resilience.

As a network organization 100RC is actively engaged in trying to meet city needs for such methods through development of new tools and curation of existing best practices. The tools and methods most needed by cities can be grouped in three subjects:

Resilience Condition – Measurement of the current state of urban resilience. Necessary to baseline existing conditions and identify opportunities to build resilience.

Resilience Potential – Measurement of the potential an initiative or program has to contribute to city resilience. Necessary to design projects and approaches with a clearly articulated resilience value proposition.

Resilience Impact – Measurement of short and long-term outcomes achieved. Necessary to create accountability and understand effectiveness.

Approaches to Measuring

Resilience Condition – 100RC's approach to measuring resilience condition combines measuring existing conditions and the risk potential of shocks and stresses under various future scenarios. Resilience condition may be understood as a city's current capacities combined with future risks. Methods for measuring resilience condition employed by 100RC partner cities include a qualitative assessment of perceived city strengths and weaknesses, an inventory of actions the city currently employs that have resilience-building potential, the use of existing data on shock and stress trends, and mapping potential interactions of shocks and stresses. These activities are primarily done with qualitative proprietary tools designed exclusively for the 100RC member network and the synthesis of existing data. Cities in the network from Surat, India to Los Angeles, USA to Thessaloniki, Greece have innovated how they apply these tools to achieve greater inclusion of stakeholders and more reliable data.

Quantitative tools for measuring resilience condition at a city-scale and applicable globally are not yet widely available. Over the next three years, however, we anticipate that this gap will be filled by tools such as the *City Resilience Index* released in May 2016 by the Rockefeller Foundation and Arup ID, and the *ISO 37120 Standard for Resilient and Sustainable Cities* being developed by the World Council on City Data.

Within a City, over-reliance on quantitative methods can obscure geographic or social disparities, provide limited visibility into the root causes that influence city performance, and fail to engage the diverse perspectives of stakeholders that are often important to understanding the story behind the data. For this reason qualitative tools and methods for further analyzing and challenging data, drawing out the insights of city experts, and assessing resilience at varying scales (block, neighborhood, etc.) remain critical.

Using a citywide resilience index or measurement to benchmark an individual city's strengths and track its progress over time can be a very useful tool—both within a city and across the network of practitioners trying to understand how best to achieve impact. However, using quantitative indices for comparing resilience condition across cities should be discouraged because of the relative and complex nature of resilience; comparing an individual city's benchmark across diverse contexts may be dangerous, as the factors that contribute to local context—and the insights for what will be necessary for enhancing resilience—will be obscured.

Resilience Potential – The challenge of this area of measurement is to connect the design of individual actions (policies, projects, programs, etc.) to what is necessary to build the city's overall resilience. A tension exists here in measuring resilience potential through specific goals (i.e. reduced traffic deaths, increased literacy, etc.) vs. intermediary outcomes (i.e. adaptive, absorptive, and anticipatory capacities as put forth by ODI). With either approach, to design resilience-building initiatives measurement methods must account for the city-specific context of risk (shocks and stresses) as well as current capacities and performance of critical functions. Methods must also be adaptable to various types and scales of actions ranging from setting city policy to designing large infrastructure projects.

Developing better methods for identifying resilience potential is of critical importance – without it cities will continue to struggle to develop sound strategies for building resilience, or will simply plan for known disaster risks and call it resilience. For example, in several cities where we work, the resilience conversation had previously focused on prevention against a handful of exogenous shocks, such as earthquakes or hurricanes or terrorism. But through the resilience planning process, underlying vulnerabilities such as water insecurity, infrastructure decay, low social cohesion and other stresses have been identified as posing a significant threat now—as well as being exaggerated in times of acute crisis—and therefore must be dealt with as part of a holistic approach to increasing a city's resilience potential.

The current gap in diagnostic tools to assess potential has been a catalyst for creativity and innovation among resilience thinkers and city experts who have stepped into this space to create processes and methods that work for them and build consensus and ownership along the way. They are largely using evaluative processes to analyze and critique project design and identify opportunities to further maximize potential resilience value. These methods include multiple-criteria analysis or a "resilience lens" to compare projects. Workshops that develop initiatives with a design thinking approach have also been widely used as a way to incorporate multiple resilience-building objectives in a given project. Some of these include the intensive workshops the United States Department of Housing and Urban Development has led (in conjunction with The Rockefeller Foundation) for awardees of the National Disaster Resilience Competition. These workshops seek to articulate the resilience value of the proposed project and to identify metrics and approaches to performance management that will ensure winning jurisdictions hold themselves accountable to achieving the full resilience value of their proposed projects.

Additionally methods are being advanced for specific sectors, particularly for capital projects and the built environment. An example of this is the *RELi Resiliency Action List + Credit Catalog*[ii], a comprehensive listing of resilient design criteria that can be used to evaluate projects and is akin to a resilience lens for U.S. Green Building Council's LEED standard (Leadership in Energy and Environmental Design). The SuRe® Standard, developed by Global Infrastructure Basel Foundation and Natixis, is another example of a well-developed infrastructure-specific tool for understanding resilience potential. It is aimed at establishing a common language of sustainable and resilient infrastructure projects between project developers, financiers, local authorities and end-users and specifically considers projects from both a risk management and a benefit creation perspective (SuRe, 2015). There is significant potential for further development and refinement of sector-specific criteria and rubrics, however, it's critical that they focus on how initiatives contribute to the resilience of the city rather than myopically measuring the resilience or robustness of the initiative itself.

As measuring resilience condition at a city scale advances, there is also the potential to downscale established indicators to apply at the initiative level across sectors.

[ii] See bibliography and http://c3livingdesign.org

Resilience Impact – Looking backward at how cities have fared shocks and stresses, the benefits of a resilience approach seem obvious. Compelling examples such as Medellin, Colombia and New York City can be found in Dr. Judith Rodin's book The Resilience Dividend: Being Strong in a World Where Things Go Wrong. But the body of evidence and measurement methods linking how actions intended to build urban resilience are delivering a resilience dividend is still developing. It is within resilience impact measurement that resilience as a practice will be tested. Practitioners will need to prove the benefits of resilience planning—showing the impact on livelihoods, the built environment, the costs of municipal finance and other metrics. And crucially, showing better outcomes in times of great stress and disaster.

Resilience impact measurement is near and dear to the heart of all cities. Cities seek to measure resilience impact at multiple scales – from that of an individual initiative to shifting the needle on the city's overall resilience. Cities are eager to show progress to their constituents and build confidence and support for continued investment. They have a keen desire to understand what is working and how they can best use scarce resources, and unlock new capital and drive investment towards resilience-building approaches.

If we get resilience condition and resilience potential measurement right, measuring resilience impact will follow naturally. Valid methods for measuring resilience condition used over time will reveal whether resilience capacity has in fact increased. Similarly, if tools for maximizing resilience potential are effective then they can be used to compare projected and realized benefits and thus measure the resilience impact at the initiative level.

Even with resilience condition and potential methods in place, however, challenges to measuring resilience impact will remain. These have been well articulated in "Resilience Measurement Principles," and include issues of causality, timeliness and avoided losses which are particularly relevant at the city scale:

- Causality – linking the actions taken to outcomes realized
- Timeliness – implementation of initiatives may take much longer than a single political cycle and benefits may not be realized until long after implementation
- Avoided losses – the impact of shocks and stresses that were avoided is difficult to measure

The valuation of resilience impact in monetary terms also remains a critical gap in establishing financing streams for resilience-building initiatives. As resilience impact measurement advances, it should bridge with other fields that value a range of direct and indirect effects such as ecosystem valuation, progressive standards for benefit/cost assessment, and risk assessments by insurers and creditors.

Annotated Bibliography

100 Resilient Cities. (2016). *About Us*. Retrieved from www.100rc.org: http://www.100resilientcities.org/pages/about-us#/-_Yz42MjM7NidpPTEocz5j/

100RC's website provides basic information about the organization, its creation, and the core offerings which member cities have access to.

Aditya V. Bahadur, K. P. (2015). *The 3AS: Tracking Resilience Across Braced.* London: UKAID & ODI.
This working paper presents a framework for measuring resilient outcomes being applied to Department for International Development (DFID)-funded Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED). It attempts to rationalize multiple existing approaches and proposes focusing on a set of interrelated resilience capacities – the capacity to adapt to, anticipate and absorb climate extremes and disasters (the 3As). In acknowledgment of the growing discourse on 'transformation', the paper also presents a workable approach to analysing the potentially transformative impact of BRACED interventions.

C3 Living Design Project. (2016). *RELi Resiliency Action List + Credit Catalog*. Retrieved from http://c3livingdesign.org/: http://c3livingdesign.org/?page_id=5110
This website provides publicly available materials on the RELi Action List and Credit Catalog. These resources suggest resilience-building design criteria for application to built-environment projects. As described by its creators, it is "similar to LEED® with a lens on resiliency." RELi was developed through an American National Standards Institute (ANSI) accredited process as a National Consensus Standard. The materials listed here support a "Resilient Property Underwriting and Finance Standard" also developed by C3 Living Design.

Food Security Information Network. (2014). *Resilience Measurement Principles* . Food and Agriculture Organization (FAO) and the World Food Programme (WFP).
This technically-reviewed paper sets out the core challenges and an ambitious agenda for the field of resilience measurement. Although not specifically focused on urban resilience, this paper and the design principles proposed are at the core of all challenges associated with urban resilience measurement. The paper also highlights general technical guidelines for use in promoting rigor in all measurement approaches.

Rodin, J. (2014). *The Resilience Dividend.* Public Affairs.
Authored by the Rockefeller Foundation's President, this book provides a range of stories illustrating how people, organizations, businesses, communities, and cities have developed resilience in the face of otherwise catastrophic challenges. These include how Medellin, Colombia, once the drug and murder capital of South America, became host to international conferences and an emerging vacation destination; how Tulsa, Oklahoma cracked the code of rapid urban development in a floodplain; how Airbnb, Toyota, Ikea, Coca-Cola, and other companies have realized the value of reducing vulnerabilities and potential threats to customers, employees, and their bottom line; how in the Mau Forest of Kenya, bottom-up solutions are critical for dealing with climate change, environmental degradation, and displacement of locals; and how following Superstorm Sandy, the Rockaway Surf Club in New York played a vital role in distributing emergency supplies.

SuRe (2015). The Standard for Sustainable and Resilient Infrastructure v 0.2, Global Infrastructure Basel Foundation and Natixis. Available on http://www.gib-foundation.org/content/uploads/2015/12/SuRe%C2%AE-v-0.2_091215.pdf

The Rockefeller Foundation, A. (2014). *City Resilience Framework.* London: Arup.

A capacities framework for understanding urban resilience. The framework is based on four aspects of resilience - health and wellbeing, economy and society, leadership and strategy, systems and services – and further broken down into 12 indicators by which resilience can be understood.

The Rockefeller Foundation, A. (2015). *City Resilience Index.* London: Arup.

Building off of the City Resilience Framework (CRF), the City Resilience Index (CRI) is being developed as a tool to measure relative performance on resilience-building capacities at a city-scale over time. It aims to provide a common basis of measurement and assessment to better facilitate dialogue and knowledge-sharing between cities.

World Council on City Data. (2015). *The WCCD and ISO 37120.* Retrieved from www.cityindicators.org: http://www.cityindicators.org/Deliverables/WCCD%20Brochure_9-16-2014-178620.pdf

The World Council on City Data (WCCD) coordinates open source city data to create a consistent and comprehensive platform for standardized urban metrics. Their leadership in developing ISO standards for use at the city-scale includes ISO 37120 which defines and establishes definitions and methodologies for a set of indicators to steer and measure the performance of city services and quality of life. There is an audit function paid for by users to gain certification which is differentiated not on scores but on a number of indicators reported.